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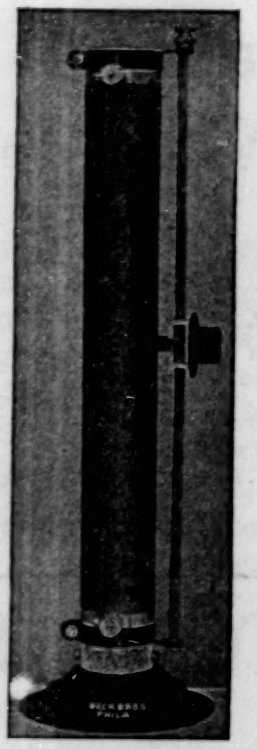

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THE ORGANIZATION OF KNOWLEDGE[1]

IN an admirable introduction to Herbert Spencer's Synthetic Philosophy, by Alfred W. Tillet, occurs the suggestive observation that "one volume after another might be glanced at or even carefully read and no idea whatever obtained as to Spencer's *aim*." Even the *Study of Sociology*, in the words of this author, "does not give any definite idea of the aim of Spencer's work" but no one "even superficially familiar with a moderate portion of Spencer's monumental contributions to knowledge can fail to be impressed by the fact that it is from end to end an organized system of scientific knowledge."

What after all is the real difference between scientific and general knowledge, or between organized and unorganized information? Is it not rather a difference in structure than in function, for, as said by Karl Pearson, "the classification of facts, the organization of their sequence, and relative significance, is the function of science," which must be the objective of every attempt to gather and classify the knowledge extant on any particular subject. The moment we desire to apply a given train of thought to some practical purpose we are confronted by the necessity of understanding facts in their relative significance.

Yet so difficult is the practical task of arriving at sound conclusions in the presence of some complex phenomenon that even civilized man reasons as a rule in disregard of scientific principles, indifferent to the value or necessity of organized knowledge as a substitute for disorganized or chaotic information. The cause of this anomaly is of course quite obvious; the former process requires painstaking care in the accumulation and classification of facts,

[1] Address of the vice-president and chairman of Section K—Social and Economic Science, Toronto, December, 1921.

while the latter is simply a convenient form of guesswork opinion, often aided by a good memory and a sound intuition. Unfortunately the truth is frequently unnecessary to the attainment of the objects of every-day existence, and there is much to be said for the view given expression to by M. Anatole France "that in the majority of cases truth is likely to fall a victim to the disdain or insults of mankind and to perish in obscurity." For unhappily, in the words of this brilliant Frenchman, "truth is inert, is not capable of modification, is not adapted to the machinations which would enable her to win her way into the hearts and minds of man" while "falsehood on the other hand possesses the most wonderful resources." Yet in the long run truth does prevail, at least in all large projects in the pursuit of knowledge or profitable trade or long range undertakings just as we build a different foundation for a pyramid than for a cowshed.

The science of forecasting has perhaps nowhere been more completely developed than in the vast businss of insurance, and of no branch of commercial enterprise can it be said with less fear of successful contradiction than of insurance that it rests its principles and policies upon the lasting and, in fact, indestructible basis of truth. Likewise, it might be said that the fame of Sir Francis Bacon rests largely upon his conception of applied science as a process of pure induction or the orderly method of arriving at trustworthy conclusions on the basis of experiment and observation or of natural laws having "the dual characteristic of universality and reality."

The inductive process of reasoning is essentially one of *fact gathering* and of classification and analysis. But systematic fact gathering as a science is of comparatively recent origin, while the urgency of organized knowledge as a prerequisite to true scientific endeavor is as yet, at least in the larger sense, only in a stage of embryonic development.

Fault has been found with Sir Francis Bacon for the barrenness of the results flowing from his laborious observations and classifications. This, as said by Church, is due to the fact that "he had a radically false and mechanical conception, though in words he earnestly disclaims it, of the way to deal with the facts of nature." The fault was one of the limitations of knowledge inherent in the age in which he lived rather than of Bacon's theory of the human understanding and of the primitive conception of the comparative value of collective phenomena or statistics, which even to this day is far indeed from having reached the status of a true science. Church is also of the curious opinion that the cause of Bacon's defect was a non-mathematical mind; that he took no notice of the invention of logarithms and that he was impatient of the subtleties of astronomical calculations. In very truth, however, the source of Bacon's transcending intellectual powers were conditioned by this very limitation of his knowledge, for as observed by Church in a subsequent passage "with all his mistakes and failures the principles on which his mode of attaining a knowledge of nature was based were the only true ones and they had never before been propounded so systematically, so fully, and so earnestly."

But Bacon suffered much more from the shortcomings of his age and its follies than from defects in his method of scientific reasoning. What to-day is known as Economics, Sociology, and Statistics, was far from having been recognized as an urgent need of a Science of Progress in which the lessons of mankind's experience are relied upon at least in commerce if not in government as controlling the rational conduct of mankind. This conception, however vaguely perceived, rests upon the larger truth, as pointed out by Herbert Spencer, that "ultimately mankind will discover a constant order even among the most involved and obscure phenomena." It is with this process that the present discussion is concerned; the organization of knowledge as differentiated from the mere gathering and accumulation of facts regardless of their interrelation or interdependence for useful purposes as the case may be.

The organization of knowledge for the present purpose is meant to include all manner of descriptive data; all observations whether

objective or subjective, all that is cognizable and recorded in the realm of human experience or as a natural phenomenon; in brief, what is Fact and Evidence, useful in the endless struggle to perfect human relations individually or collectively in the pursuit of all that concerns a higher and more effective standard of life, labor, and social happiness.

The principle is laid down as incontrovertible that most of the ills from which mankind suffers are the result of chaos and confusion in the boundless domain of knowledge and the misunderstanding of the why and wherefore of life in the higher and larger sense. This applies as much to the earning of a livelihood or success in commerce and trade as to the affairs of nations and questions of peace and war. A League of Nations not based upon completely organized and unified knowledge is as foredoomed to failure as a merchant adventure in ignorance of the market to which it applies. Yet less progress has been made in the direction of organizing the data of human experience on the basis of a well-considered plan than has been made in the case of any other single branch of science or business enterprise. Of the collection of data there is no end, nor of the accumulation of books and the making of card indexes; but this is often not an aid but rather a hindrance to the organization of knowledge in the sense and for the purpose indicated. It is largely due to this defect in the Baconian philosophy that the practical results of Bacon's theories fall so far short of their theoretical possibilities. In the same sense it is a safe statement to make that the practical value of a public library at the present time is but a fraction of its possible utility were it properly conceived on the principles of organized knowledge.

It was the opinion of Herbert Spencer that "The sciences can not be arranged rationally in a serial order." Yet numerous have been the attempts to classify the sciences from Bacon and Spencer to modern workers, including the fragmentary observations of Mercier. Perhaps the most useful remarks on classification are those of Jevons in the second volume of his "Principles and Science," but in this as in all similar discussions the true objective, the organization of knowledge, is lost sight of. Nearer to the point are Spencer's data on Sociology but wholly impractical for everyday needs, being rather a classification of information than of knowledge or verifiable evidence.

Nor is the question much advanced by such a learned work as "The Organization of Thought" by Professor Whitehead, although it is properly observed that "first-hand knowledge is the ultimate basis of intellectual life," and the further and extremely interesting and practically valuable conclusion that "The second-handedness of the learned world is the secret of its mediocrity. It is tame because it has never been scared by facts," and finally that "The main import of Sir Francis Bacon's influence does not lie in any particular theory of inductive reasoning which he happened to express, but in the revolt against second-hand information in which he was the leader." (p. 43).

This is precisely the point raised in this protest against the apathy of the so-called scientific mind, which is often satisfied with doubtful or incomplete information because forsooth it is a task of colossal difficulty to collect and properly organize the information on almost any subject whatever. But the difficulty arises chiefly out of an unorganized or disorganized state of mind, habituated to a pretense of knowledge full well known to be imperfect and incomplete. The defects or deficiencies are therefore often made up by the use of mathematics, by every conceivable method of abstract reasoning as a substitution for the want of sufficient concrete evidence which more systematic and qualified research would bring forth.

Completely unified knowledge, from the viewpoint of Spencer, is unattainable in any field of human endeavor, but the approximately complete organization of the knowledge extant on any particular subject at the present time is not only feasible but an imperative *duty*. The use of mathematics is, under such circumstances, more of a hindrance and a pretense than a help. What is wanted is *more*

and better understood control of organized information.

The organization of knowledge involves as a first consideration the synthetic collection of facts, and a fact in the present sense is construed as defined by Webster, as "Anything that is done or happens, as an act or deed, anything actually existing, and anything strictly true." But aside from this narrow definition of facts in the more restricted sense the organization of knowledge involves as a secondary consideration the collection and classification of information, which may or may not be strictly true but of relative value sufficient for the purpose. Information is defined as "knowledge acquired or derived, or as timely specified knowledge, sufficient for the ordinary needs of life and the basis of the large majority of judgments upon which human conduct is regulated." To these preliminary definitions must be added the term knowledge itself or "the clear and certain apprehension of the truth or assured rational conviction." This is not knowledge in the ordinary sense of the term, for we *know* much of what is not clearly apprehended at all. As said by Webster, "Knowledge is *all* that the mind knows, from whatever source derived or obtained or by whatever process; the aggregate of facts, truths, or principles acquired or retained by the mind, including alike the intuition native to the mind and all that has been learned respecting phenomena, causes, laws, principles, literature, etc."

With these principles clear in mind the task of the organization of knowledge is less difficult. It is immaterial what subject is selected; the Seal Fisheries of Alaska or the Climatic Conditions of the Falkland Islands; The Development of the Export Trade in the Basin of the Amazon River or The Theory, Practice, and Results of Insurance. The process of organizing the facts of any branch of knowledge is the same however much the nature of the data may vary, or their extent in time and place. Facts must first be looked upon as information—as mere knowledge irrespective of intrinsic worth; they are the raw material which, subjected to qualified critical and impartial consideration, forms the ground work of science inductively conceived. Science has been defined as "Knowledge gained and verified by exact observation and correct thinking," and also as the sum of universal knowledge, or in other words "an exact and systematic statement of knowledge concerning some subject or group of subjects." Now a systematic statement of knowledge is organized knowledge, and in this sense much of what is called scientific falls far short of the required essentials of a true science. Webster's definition is admirable but of itself incomplete. For it would seem of the first importance to emphasize the need of organized knowledge as a conception of science in the more restricted sense of the word.

This must have been recognized by Webster, who goes on to qualify his definition of science as follows: "Knowledge of a single fact not known as related to any other, or of many facts not known as having any mutual relation, or as comprehended under any general law, does not reach the meaning of science," for, he adds, "science is knowledge reduced to law and embodied in a system." This process is primarily one of organizing the data of science and of subsequent classification and analysis, out of which the principles of science are logically evolved by a process of pure induction. It is held that this process of organization aiming at complete unification of the knowledge of any particular subject or group of subjects is as yet but very imperfectly realized in the manner most conducive to practical results.

In other words, the objective of organizing knowledge is the accessibility of facts useful for the purpose of selection for particular and practical purposes. In the words of M. Poincare, "Scientists believe that there is a hierarchy of facts and that a judicious selection can be made," and furthermore that "The most interesting facts are those which can be used several times, those which have a chance of recurring." He then asks the question "Which then are the facts that have a chance of recurring?" and he replies that in the first place simple facts "although facts which appear

simple even if they are not so in reality will be more easily brought about again by chance."

It is upon this conception that a practical science of organized knowledge on any subject must rest. Simple facts are the ground work of sound reason or the common sense of every-day questions; facts which are known to recur with regularity, particularly such as are in the form of statistics "systematized numerical facts collectively" considered and which form the basis of judgments concerned with forecasting the future more or less in conformity to the principle of or the law of probability. This has been defined as "the ratio of chances favoring an event to the total number of chances for and against it." Obviously no sound judgment involving the future can be arrived at without a knowledge of what has taken place in the past, and yet an immense number of opinions are rendered in total disregard of the lessons of past experience. But as M. Poincaré observes, "although it is with regular facts that thought ought to begin, as soon as the rule is well established, as soon as it is no longer in doubt, the facts which are in complete conformity with it lose their interest, since they can teach us nothing new." Thus, while on the one hand the lessons of experience are only too often ignored or set aside, there is on the other frequent failure to recognize the limitations of experience and to scorn the "exception which becomes important."

The foregoing brief exposition of certain principles of science applied to the systematic collection of facts in the accepted sense will serve the purpose of emphasizing that in its final analysis all fact gathering, fact arrangement, and fact comparison has for its primary objective the approximate certainty of the truth in its application to the needs of every-day life. At least in this sense my own efforts have been construed not upon a well-defined theory but in coincident adaptation to my needs, strongly influenced by the profound conviction that only the broadest understanding of any given subject is likely to prove trustworthy, that all collateral or related facts must be taken into account, that the knowledge must be sufficient in quantity as well as extended in point of time while absolutely free in its gathering from any bias or prejudice.

The procedure of fact gathering is much more arduous than is assumed by amateurs satisfied with the collection of mere information and the mechanical indexing of data divorced from practical use. In my judgment it is of the very first importance that the fact gatherer should be the fact user, or, in other words, the one to apply the results of his research to the solution of the problems of every-day life. Nothing is more likely to be harmful than when the fact gathering is done mechanically or without a definite objective.

The organization of knowledge, in its final analysis, is concerned with the task of assembling the facts of human experience in a form conveniently available and adaptable to every-day needs. In brief, the very purpose of organization and classification is to bring order out of chaos, and yet, in the words of Boutroux, "In the reality of things, the right eternal, mathematical order which science considers from its own point of view serves to obscure an order that is invisible, subtle, supple and untrammeled and therefore all the more beautiful." But mankind can not do without the latter any more than the former and it is therefore of the utmost importance that the knowledge organized or arranged and classified shall be as nearly as possible complete or inclusive of all the experience that has been had in a given matter. For as further observed by Boutroux, "It is beyond dispute that our reasonings are susceptible to being in harmony with facts," for "when they are out of harmony we do not consider that reasoning is a conscious instrument but rather that we have insufficient data, that our field of opportunity is too limited." Hence the supreme need of a clear grasp of the methods of inductive reasoning as opposed to those of deductive logic, since the former is based on experience while the latter is not.

The practical ideal of good judgment in matters of our every-day living needs is expressed by Spedding, the biographer of Bacon, in the words "I doubt whether there was ever any man whose evidence upon matters of fact may be

more absolutely trusted," yet it is equally true, as observed by Cowley, quoted by Robinson, that "Bacon missed success in detail because he was striving to encompass nearly the whole field of nature in a life which was engrossed with work enough of other kinds to keep a strong man busy." But Bacon suffered even more from the absence of a clear recognition on the part of the age in which he lived of the truth fundamental to his aims, that information and belief are not a substitute for a knowledge of facts and a recognition of their relative importance. The purpose of the Baconian philosophy is contained in the prediction that "Men's power over nature would be increased a thousand fold when they learned to interpret her with the humility of truth seekers casting aside all prepossessions," a prediction realized in no small measure in modern life freed from a vast amount of the credulity, deliberate falsehood, and class bias, which mar the greatest achievements of Bacon's time.

But mankind is still a long distance from having recognized that truth alone can make us truly free. There is, no doubt, a considerable degree of practical utility in common errors. Since all of our human relations are based on relative conceptions of truth the margin of error may be large or small as circumstances permit, but only for short range efforts. It matters little whether the distance I am to walk is a mile, or nine-tenths, or even less in my estimation, but it makes a world of difference whether the calculated position at sea is correct within a small fraction of the longitude and latitude determined by the sextant. And just as surely as small errors repeated and accumulated lead to disaster at sea, so more serious errors in conduct, individual or social, may defeat a course laid out in ignorance of the truth.

The clearest recognition of this principle of right action is the statement by Mill in his discourse on "Fallacies of Observation," in connection with which it is said that "A fallacy of misobservation may be either negative or positive; either non-observation or mal- observation." This important distinction is explained in part that "It is non-observation when all the error consists in overlooking or neglecting facts or particulars which ought to have been observed. It is mal-observation when something is simply unseen or seen wrong; when the fact or phenomenon instead of being recognized for what it is in reality is mistaken for something else."

Both errors are of such common occurrence in every-day life that they are the rule rather than the exception among those whose judgments are relied upon as a matter of course in the conduct of affairs of the first importance. Mill recognized this limitation of the average understanding, pointing out in his discussion of Fallacies that "In the conduct of life—in the practical business of mankind—wrong inference, incorrect interpretation of experience, unless after much culture of the thinking faculty are absolutely inevitable; and with most people after the highest degree of culture they ever attain, such erroneous inferences, producing corresponding errors in conduct, are lamentably frequent." Yet as clearly as this is stated and admitted as a fact of every-day experience, generation after generation grows up in ignorance of the inherent limitations of the human understanding, the serious danger of unorganized knowledge, and the menace of a continuous stream of mere information much of which is only guesswork, possibly grossly false in matters of detail, while all of it, by itself, may be totally unrelated to the practical needs of every-day life.

There is an imperative demand for accuracy in public utterance which falls lamentably short of the ideal. Statesmen utter weighty opinions on matters of verifiable knowledge obtuse to the implication of wilful ignorance, if not wilful deception. Even in high places the most vague distinctions prevail between what is mere opinion and what is fact and truth. Almost half a century ago George Cornwall Lewis in a very readable treatise on the "Influence of Authority in Matters of Opinion" called attention to the need of a clear grasp of this distinction, holding that "a large proportion of the general opinions of mankind are derived merely from authority and are entertained without any distinct understand-

ing of the evidence on which they rest." Authority in this sense means "the principle of adopting the beliefs of others on a matter of opinion without reference to the particular grounds on which that belief may rest." The profound error implied in the blind or unreasoning acceptance of the views of others is the most serious menace to present-day civilization, and the growing habit of accepting as conclusive the views of men possibly as ill-informed as they may be influenced by wrongful motives, simply because they audaciously emphasize and reemphasize mere opinions as statements of fact, involves the very integrity of the intellectual life of the age.

The half-educated, but possibly well informed, do not realize the truth that "the formation of opinion by authority can never (except by indirect means) produce any increase or improvement of knowledge or bring about the discovery of new truths," or, in other words, progress for its attainment depends upon intellectual virility, independence of thought, and judgments impartially arrived at. In the large majority of matters men must rely upon the opinions of others, but here again, in the words of Lewis, "It is of paramount importance that truth and not error shall be accredited; that men when they are led by opinion should be led by safe guides." Hence the importance of an intellectual standard which shall insist upon fact gathering, reflective analysis, and verifiable knowledge in all matters fairly within the compass of a mind of average intelligence. It was the weakness of the German educational system, so largely copied or adopted in this country, that it made respect for authority its cornerstone to the infinite harm of the countless many who fell victims to the soul-deadening policy of the Super-State.

Essentially progress and discovery depend, in the words of Karl Pearson, upon a disciplined imagination and while "the man with no imagination may collect facts" it is equally true that "he cannot make great discoveries." As perhaps the most illustrious examples, he cites Farraday and Darwin, who were both fact gatherers but at the same time gifted with a brilliant imagination. But the imagination will fail unless it is a disciplined one, and all discipline leads, unconsciously perhaps, to the development of the critical faculty. Yet this faculty is to-day the least regarded—looked upon as mere fault-finding, when in very truth, in the words of Pearson, "Criticism is the essence of the scientific use of the imagination, in fact the very life blood of science."

An excellent practical illustration is E. Ray Lankester's essay on the "History and Scope of Zoology," originally contributed to the Ninth Edition of the Encyclopædia Britannica. (Reprinted in his "Advancement of Science," London, 1890). The author observes that "The possibility of verification established verification as a habit; and the collection of things (or facts) instead of the accumulating of reports (or mere information) developed a new faculty of minute observation." But it did much more. It developed at the same time the judgment qualified to draw correct conclusions both as to the nature of things and causation. To-day there is the most serious danger that the ever-increasing amount of mere information on countless questions as wide apart as the universe, made accessible anywhere to those who can read—through books, newspapers, and motion pictures, will, in the absence of a clear recognition of the fundamental principles of the limitations of the human understanding, lead to hopeless confusion in matters essential to every-day living. There was never a greater fallacy uttered than "Knowledge is Power," for it is by no means mere knowledge or information that gives support to creative intelligence, but the understanding alone aids the disciplined imagination ever on the search for new truths or the larger and better use of the truths or facts already known.

Sir E. Ray Lankester refers to the immense influence of the Royal Society in the seventeenth century when "It laid down definite rules for its guidance, designed to ensure the collection of solid facts and the testing of statements embodying novel or remarkable conclusions." Nothing would give more substantial furtherance to the cause of truth than

if this practice were adapted to-day by all scientific bodies as a first essential to conserve the precious intellectual heritage of the past against the menace of falsification and error and ridicule. To-day, unfortunately, there is not the serious jealousy against the inroads of the imposter and amateur now into one branch of science, now into another. Conversely, there is need of a broader scientific spirit, of a more hearty encouragement of all seekers after truth, in place of the narrow-minded attitude so often displayed by men who could be of the greatest aid to those who are doing pioneer work outside of the recognized field of the scientist of the academies. Sir E. Ray Lankester illustrates this point by calling attention to the fact that "The delay in the establishment of the doctrine of organic evolution was due not to the ignorant and unobservant but to the leaders of zoological and botanical science," an attitude of hostility which has by no means passed away.

I can not do better than draw one further observation from Sir E. Ray Lankester's essay: "Outside the scientific world an immense mass of observations and experiments had grown up in relation to this subject (genetics). From the earliest times the shepherd, the farmer, the horticulturalist, and the 'fancier' had for practical reasons made themselves acquainted with a number of biological laws and successfully applied them without exciting more than an occasional notice from the academic students of biology." But, he adds, "It was one of Darwin's great merits to have made use of these observations and to have formulated their results to a large extent as the laws of variation and heredity."

Over-specialization is developing a type of scientific mind as much to be guarded against as the credulous and ignorant. The limitations further emphasize the necessity of a broad scientific spirit anxious to give furtherance to the seeker after truth in whatever direction and by whatever methods useful results may be obtained. For, in its final analysis, every discovery rests primarily upon the power of observation or fact gathering, and discrimination and aptitude in fact classification and analysis, which may or may not require the aid of modern instruments of precision. Modern man is only too apt to forget the vast achievements of the ancients. The four greatest inventions of an earlier period were all made without the modern aids to scientific discovery, but by men gifted with a disciplined imagination. Printing, Gunpowder, Steam, and the Compass did more to change the face of the world and the fortunes of mankind than Electricity, Wireless Telegraphy, Motion Pictures, and the Graphophone.

The foregoing observations have been included in the present discussion to further emphasize the view that a true organization of knowledge is essential to the future of scientific discovery, as well as to the needs of the more complex life of to-day and of the years to come. But more than this would I try to make clear the conclusion that science in the more restricted technical sense should do more to encourage the development of science in the larger or more universal sense, and therefore enlist the aid of any and all means available in place of a narrow spirit of aloofness unworthy of the aims and ideals of the sincere seeker after truth.

FREDERICK L. HOFFMAN
THE PRUDENTIAL INSURANCE
COMPANY OF AMERICA,
NEWARK, N. J.

(To be concluded.)

THE FIFTH YEAR OF THE TROPICAL RESEARCH STATION

THE Fifth Expedition of the New York Zoological Society to the Tropical Research Station at British Guiana, sailed on the "Maraval" on February first, with nine members under Director William Beebe. As in previous years, the chief assistant is Mr. John Tee-Van. Mr. Paul Howes, who was a member of the first expedition, will work on the field staff. The artist is Miss Mabel Cooper who is completing her remarkable series of drawings from the life of living reptiles, amphibians and fishes. The party will continue tropical research at Kartabo until after the long rainy

season, when a sub-station will be established upriver at Kaieteur Falls for the study of this elevated fauna, which differs considerably from that of the coast.

The researches of Director Beebe on the syrinx of birds will be continued, as well as intensive studies on primitive living types in their environment, especially *Peripatus,* the hoatzins, the armored catfishes, and on the entire environmental complex. The remaining hoatzin material for the American Museum group will be collected and data completed for one hundred large colored plates to be issued in a series of volumes uniform in size with Director Beebe's "Monograph of the Pheasants." It is hoped that the Station may be kept open throughout the year and through the succeeding winter of 1922-1923, to permit a number of British zoologists to come from England and begin work at the Station. Moving pictures of mammals, birds, and reptiles will be taken of all the subjects studied, and large mirrors have been secured for photographing in the deep jungle.

The work in the Tropical Research Station during the year 1921 may be best presented in calendar form. From January 1 to March 15 the expedition continued in the field, each member pursuing his or her particular line of research. Unusual discoveries were made in the Director's study of the syrinx of birds, for example, that in certain decapitated birds every note can be reproduced by manipulation of the lungs and trachea. On February 12 an important trip was made to Kaieteur Falls, the party including Mrs. Theodore Roosevelt and four members of the Station's staff. Many new and interesting specimens were collected and the ground thoroughly surveyed for the establishment of a sub-station another year. The Falls are the highest in the world, eight hundred and ten feet in all, about five times as high as Niagara. Upon return to Kartabo the regular exploration and research were resumed. The expedition returned to New York in April. Owing to a very serious fire on board the steamer at St. Kitts, the entire collection, instruments and equipment required a thorough overhauling and repairing. The photographic negatives especially had to be removed from their envelopes and washed, and the microscope boxes reconstructed. The collection of live animals brought to the Zoological Park included the Crested Curassow, South American Rattlesnake, Boa, Giant Anteater, Capuchin Monkey and Caiman. The most notable was a young Red Howling Monkey, George by name, the first ever brought up successfully and established in the collections of the Zoological Society.

The members of the 1921 expedition are now widely scattered. Professor J. F. M. Floyd returned to his department in the University of Glasgow; Dr. Alfred Emerson now holds the position of Assistant Professor in the University of Pittsburgh, and Clifford Pope is engaged in herpetological work in central China with the American Museum Asiatic Expedition. During the period of May to December Director Beebe completed the manuscript and proof of Volume III of the Pheasant Monograph, and completely finished the manuscript of Volume IV. The entire British Guiana collections were catalogued, index files established, and much of the vast quantity of material arranged and correlated ready for publication after another season's accretions. Several weeks were devoted to perfecting a new method of hand-colored lithography, which will be put into operation next year in issuing the series of one hundred large colored plates, together with life histories. During October to December, in aid of publicity, Director Beebe gave about twenty-five lectures in various cities, dealing with the work and activities of the Tropical Research Station. Addresses were also made before the New York Academy of Sciences, the American Geographical Society and the Annual Meeting of the Trustees of the New York Zoological Society. During the year twenty-six publications were issued.

H. F. O.

ZOOLOGICAL SOCIETY,
FEBRUARY 17, 1922

GRANTS FOR RESEARCH MADE BY THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE Committee on Grants held its annual meeting in New York on January 1, 1922, and distributed four thousand dollars which was assigned by the council of the association for the current year. Three members of the committee, Messrs. Crew, Parker, and Stebbins, having retired at the end of 1921, the present organization of the committee is: Robert M. Yerkes, *Chairman;* F. R. Moulton, *Secretary;* E. G. Conklin, C. Judson Herrick, Arthur B. Lamb, George T. Moore, E. L. Nichols, and David White.

Following is the list of grants for 1922:

PHYSICS

One hundred and fifty dollars to Professor A. W. Smith, Ohio State University, in support of his work on the latent heat of fusion and on the specific heat of metals.

One hundred and fifty dollars to Professor L. R. Ingersoll, University of Wisconsin, in support of his work in magneto-optics.

One hundred and fifty dollars to Professor F. C. Blake, Ohio State University, for partial payment toward the cost of an X-ray spectrometer.

CHEMISTRY

Two hundred and fifty dollars to Dr. A. W. Rowe, Evans Memorial Hospital, Boston, for the study of the basal metabolic rate in pregnancy.

Two hundred dollars to Professor Harold Hibbert, Yale University, for a study of the oxidation potentials in related organic substances.

One hundred dollars to Professor W. C. Rose, School of Medicine, University of Texas, in support of a study of blood changes in nephritis.

ASTRONOMY

Two hundred dollars to the American Association of Variable Star Observers for a portable house to go with the telescope purchased from a previous grant.

One hundred dollars to Miss Caroline E. Furness, Vassar College, additional to previous grant for determining proper motions of stars.

One hundred dollars to Dr. Sebastian Albrecht, Dudley Observatory, additional to previous grant for assistance in study of stellar spectra.

GEOLOGY

Two hundred and fifty dollars to M. Ferdinand Canu of Versailles, France, in further support of his work on bryozoa.

One hundred and fifty dollars to Dr. August Foerste, High School, Dayton, Ohio, toward travel and office expense in the preparation and description of arctic fossil cephalopods.

ZOOLOGY

Two hundred and fifty dollars to Professor Hermann J. Muller, University of Texas, to carry out studies on mutations in flies.

Two hundred dollars to Professor S. O. Mast, Johns Hopkins University, to carry on work on locomotion of amœba.

BOTANY

One hundred and twenty five dollars to Dr. Ralph C. Benedict, Brooklyn Botanic Garden, in further support of a study of the fern genus Nephrolepis.

Two hundred and fifty dollars in support of Botanical Abstracts for the current year.

One hundred and twenty five dollars to Professor John T. Buchholz, University of Arkansas, in support of work on pollen tubes.

PSYCHOLOGY

Four hundred dollars to Professor Raymond Dodge, Wesleyan University, for the development of an instrument for recording eye movements.

Three hundred dollars to Professor Franklin O. Smith, Johns Hopkins University, for the purchase of a monochromatic illuminator to be used in research on color vision.

PHYSIOLOGY

Two hundred dollars to Professor Fred T. Rogers, Baylor Medical College, for a study of the marsupial brain.

Two hundred dollars to Professor Frank P. Knowlton, Syracuse University, in further support of the study of the blood flow and gaseous metabolism of the thyroid gland.

One hundred and fifty dollars to Professor Frank A. Hartman, University of Buffalo, to aid in the further study of suprarenal insufficiency.

JOEL STEBBINS,
Secretary Committee on Grants.
URBANA, ILLINOIS

SCIENTIFIC EVENTS

THE EXHIBITION OF THE ROYAL PHOTOGRAPHIC SOCIETY

THE Royal Photographic Society of Great Britain is holding its sixty-seventh annual exhibition in September and October of this year. This is the most representative exhibition of photographic work in the world, and the section sent by American scientific men heretofore has sufficiently demonstrated the place held by this country in applied photography. It is very desirable that American scientific photography should be equally well represented in 1922, and, in order to enable this to do be done with as little difficulty as possible, I have arranged to collect and forward American work intended for the Scientific Section.

This work should consist of prints showing the use of photography for scientific purposes and its application to spectroscopy, astronomy, radiography, biology, etc. Photographs should reach me not later than Thursday, June 15. They should be mounted but not framed.

I should be glad if any worker who is able to send photographs will communicate with me as soon as possible so that I may arrange for the receiving and entry of the exhibit.

A. J. NEWTON
THE EASTMAN KODAK COMPANY,
ROCHESTER, N. Y.

FRENCH EXCHANGE PROFESSORS IN ENGINEERING

THE *Pennsylvania Gazette* reports that Professor Jacques Cavalier, rector of the University of Toulouse, has begun his term at the University of Pennsylvania as the first exchange professor appointed by the minister of public instruction in France in accordance with an arrangement made by the committee of American universities on exchange with France of professors of engineering and applied science. The plans made by the committee stipulate that the French exchange professor shall spend one month at each of the following universities: Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, University of Pennsylvania and Yale, and that a representative of American technical schools shall spend a year visiting and lecturing before the chief French engineering and technical schools.

Professor Cavalier is an eminent scientist and well known as an investigator in the field of metallurgical chemistry. He was formerly professor of applied chemistry at the University of Rennes, and he is now rector of the University of Toulouse. During the war he was attached to the ministry of munitions. Since his appointment to the post of rector of the University of Toulouse he has devoted much of his time to questions related to technical education.

During his stay in America he hopes to thoroughly study the organization administration and methods of instruction in our own schools and place before men interested in technical education the principles underlying scientific education in France. It is believed that this exchange of professorships will serve to develop a cordial relationship between engineering and technical schools in both countries. Professor Cavalier will lecture before the staff and graduate students of the department of chemistry on questions related to his own investigations in applied chemistry, and he will also deliver three illustrated lectures in French at Houston Hall on Wednesdays, March 1, March 8 and March 15, on 'The French universities," "Student life in France," and the "Evolution and development of the French universities." Both as a savant and scholar, Professor Cavalier is well equipped to speak on the advanced studies now carried on in French universities, as well as to discuss their organization.

The committee of American universities has appointed as its representative in France this year Professor Arthur E. Kennelly, professor at Harvard and the Massachusetts Institute of Technology. Professor Kennelly has met with so much success in his mission that the number

of institutions to be visited by him has been doubled in order that more universities could hear his lectures on the development of scientific education in this country.

OFFICERS OF ENGLISH SCIENTIFIC SOCIETIES

ELECTIONS to office in English societies devoted to physical sciences are reported in *Nature* as follows:

The annual general meeting of the Physical Society of London was held on February 10, and the following officers and members of council were elected: *President:* Dr. A. Russell. *Vice-presidents:* Lord Rayleigh, Professor T. Mather, Mr. T. Smith, and Professor G. W. O. Howe. *Secretaries:* Mr. F. E. Smith, "Redcot," St. James's Avenue, Hampton Hill, and Dr. D. Owen, 62 Wellington Road, Enfield. *Foreign Secretary:* Sir Arthur Schuster. *Treasurer:* Mr. W. R. Cooper. *Librarian:* Dr. A. O. Rankine. *Other Members of Council:* Mr. C. R. Darling, Professor C. L. Fortescue, Dr. E. Griffiths, Dr. E. H. Rayner, Mr. J. H. Brinkworth, Mr. J. Guild, Dr. F. L. Hopwood, Dr. E. A. Owen, Dr. J. H. Vincent, and Dr. G. B. Bryan.

The following officers and members of council of the Royal Astronomical Society were elected at the anniversary meeting on February 10: *President:* Professor A. S. Eddington. *Vice-presidents:* Dr. J. L. E. Dreyer, Sir F. W. Dyson, Professor A. Fowler and Professor H. F. Newall. *Treasurer:* Col. E. H. Grove-Hills. *Secretaries:* Dr. A. C. D. Crommelin and the Rev. T. E. R. Phillips. *Foreign Secretary:* Professor H. H. Turner. *Council:* Professor A. E. Conrady, Dr. J. W. L. Glaisher, Mr. P. H. Hepburn, Mr. J. Jackson, Dr. H. Jeffreys, Professor F. A. Lindemann, Dr. W. H. Maw, Professor T. R. Merton, Professor J. W. Nicholson.

At the annual general meeting of the Royal Meteorological Society on January 18 the following officers were elected: *President:* Dr. C. Chree. *Vice-presidents:* Mr. C. L. Brook, Mr. W. W. Bryant, Mr. R. H. Hooker and Dr. E. M. Wedderburn. *Treasurer:* Mr. W. Vaux Graham. *Secretaries:* Mr. J. S. Dines, Mr. L. F. Richardson and Mr. Gilbert Thomson. *Foreign Secretary:* Mr. R. G. K. Lempfert. *Council:* Dr. J. Brownlee, Mr. D. Brunt, Mr. C. J. P. Cave, Mr. J. E. Clark, Mr. R. Corless, Mr. Francis Druce, Mr. J. Fairgrieve, Col. H. G. Lyons, Mr. Henry Mellish, Sir Napier Shaw, Dr. G. C. Simpson and Mr. F. J. W. Whipple. Communications should be addressed to the secretaries at 49 Cromwell Road, South Kensington, S.W.7.

THE GEOLOGICAL SOCIETY OF CHINA

ON January 27, 1922, there was organized in the Geological Survey quarters in Peking, the Geological Society of China with 22 charter members (fellows). The aim of the society is to unite all working geologists in China into a scientific body for the advancement of the science of geology and its kindred subjects in general, and the geology of China in particular. The society will hold an annual meeting for the presentation and discussion of papers, for election of officers and transaction of business. Other meetings will be held during the year when deemed desirable. The membership consists of fellows and associates, the former comprising active workers in geology and kindred sciences, including paleontology, mineralogy, petrology, mining geology, etc., the latter including advanced students in these sciences. The society will issue a publication under the name "Bulletin of the Geological Society of China." The following officers have been elected:

President: Dr. H. T. Chang. *Vice-presidents:* Dr. W. H. Wong and Professor J. S. Lee. *Secretary:* Mr. C. Y. Hsieh. *Treasurer:* Mr. H. T. Li. *Councilors:* Dr. V. K. Ting, Dr. J. G. Andersson, Dr. A. W. Grabau, Professor Leigh Wang, Dr. C. Y. Wang (Hupeh), Mr. C. Tuan.

THE SCHOOL OF HYGIENE AND PUBLIC HEALTH OF THE JOHNS HOPKINS UNIVERSITY

AS was noted in last week's SCIENCE the Rockefeller Foundation has made a gift of $6,000,000 to the Johns Hopkins University for endowment and buildings for the school of hygiene and public health.

Since this school was opened in 1918 the Foundation had furnished the funds required for its maintenance from year to year. With the acceptance of the present gift the trustees of the university assume full responsibility for the future needs of the school as they develop.

This new type of institution places emphasis upon the development of preventive medicine and upon the training of health officers. Under

the direction of Dr. William H. Welch the school has made substantial progress in the four years since it was established. Twenty-seven states and ten foreign countries are now represented in the student body numbering 131. The faculty of the school comprises scientists in the fields of bacteriology and immunology, sanitary engineering chemical hygiene, physiological hygiene, medical zoology, epidemiology, vital statistics and public health administration.

The regular courses of study lead to the degrees of doctor of public health, doctor of science in hygiene, and bachelor of science in hygiene. A certificate in public health is given to those completing certain special courses. Short courses or institutes are provided for health workers in service who cannot be absent from their positions for more than a few weeks at a time. Last year thirty-six health officers from eight states took these short intensive courses.

Up to this time the school has been housed in old buildings, situated in the center of the city of Baltimore, and formerly used by Johns Hopkins University for laboratories of physics, chemistry and biology. The present gift, in addition to providing endowment, will make possible the erection of the new building for the school on a site adjacent to the Johns Hopkins Medical School and Hospital.

Work on the main building, the plans for which already have been drawn, is expected to start this summer. It will be located on a site which has already been acquired at the southeast corner of Monument and Wolfe streets and is so designed as to admit of its liberal expansion. The contract for its erection will be let as soon as the architects, Archer & Allen, of Baltimore, have completed drawing the detailed specifications.

The enterprise will be part of a general scheme of building to be started by the university this year, including in addition to the new school of hygiene, which will cost $1,000,000, $800,000 for the new Woman's Clinic and a new pathological building, the contracts for which have already been let; $500,000 for a new chemical laboratory at Homewood and between $400,000 and $500,000 for dormitories at Homewood.

SCIENTIFIC NOTES AND NEWS

DR. JOHN CASPER BRANNER, the distinguished geologist, president emeritus of Leland Stanford University, died on March 1 at the age of 71 years. He was the second president of the university, succeeding Dr. David Starr Jordan, who now is chancellor emeritus.

A MEETING to initiate the Gorgas Foundation Memorial was held at Birmingham, Ala., on March 4. Among the speakers was Sir Auckland Geddes, the British ambassador, who said: "The name Gorgas will live long after the peoples of earth have forgotten the heroes of the world's greatest war."

DR. HUBERT WORK has taken the oath of office as postmaster general. Dr. Work, whose home is at Pueblo, Colorado, is president of the American Medical Association. President Harding's cabinet contains a physician and an engineer, which represents a new development of political institutions in the United States.

PROFESSOR SOLON I. BAILEY, of the Harvard College Observatory, sailed on March 1 from New York to Peru to take charge of the Harvard astronomical station at Arequipa. He is accompanied by Mrs. Bailey and by Miss Annie J. Cannon of the observatory staff.

DR. HENRY H. RUSBY, who was forced through illness to quit the leadership of the Mulford Biological Exploration of the Amazon Basin, has arrived in New York, his health being now much improved. Dr. Rusby turned the leadership over to Dr. W. M. Mann, assistant curator of the Division of Insects, National Museum. Dr. O. E. White, of Brooklyn Botanical Gardens, has charge of the botanical work.

PROFESSOR DOUGLAS W. JOHNSON, of Columbia University, delivered the Heilprin Memorial Lecture before the Geographical Society of Philadelphia on March 1. Preceding the lecture, Professor Johnson received from President Bryant the Elisha Kent Kane Medal, awarded to him by the council of the society.

ACCORDING to a press dispatch the Belgian geologist, Professor Scouppe, of the University of Ghent, has just returned from the Belgian Congo where he located two radium deposits,

said to be the richest in the world. Professor Scouppe christened the mineral "Curite." The Belgian authorities have started the construction of a plant at Hoboken near Antwerp, which, it is said, will produce one gram of radium from nine tons of the mineral.

AT a meeting of the C. M. Warren Committee of the American Academy of Arts and Sciences, held on Tuesday, February 21, it was voted to make the following grants: To Professor R. F. Brunel, of Bryn Mawr College, $200 to assist him in his work on the study of the action of halogen hydrides on unsaturated compounds. To Professor V. K. Krieble, of Trinity College, $100 to aid his investigation of the nature of asphalts. It was voted by the committee that applications for grants would be considered at three stated meetings of the committee each year. Applications for grants should be in the hands of the chairman of the committee, Professor James F. Norris, Massachusetts Institute of Technology, Cambridge, by the first of February, May or November.

MR. G. V. COLCHESTER has been appointed to the post of geologist on the Geological Survey of the Anglo-Egyptian Sudan in succession to Mr. C. T. Madigan, who now holds a lectureship in geology at Adelaide University.

MR. HOWARD T. GRABER has been elected secretary of the Digestive Ferments Company, Detroit. Mr. Graber retains his former duties as director of the Chemical Laboratory and chairman of the publicity committee.

MR. EDMUND B. STILES, formerly with the Subsurface Department of the Bureau of Economic Geology of the University of Texas, and W. Armstrong Price, formerly paleontologist for the West Virginia Geological Survey and lately with the Transcontinental Petroleum Company in Tampico, are now engaged in subsurface studies for F. Julius Fohs, chief geologist of the Humphreys Oil Company, at Dallas, Texas.

THE fifth Hanna lecture was delivered on February 24 at the Medical Library, Cleveland, by Professor Joseph Barcroft, F.R.S., fellow of Kings College, Cambridge, England, on the subject of "The physiology of life at high altitudes."

DR. A. C. CREHORE, of the Nela Research Laboratory, gave a series of lectures from February 14 to 23 at the University of Illinois on the general subject: "Modern theories of the structure and behavior of atoms."

DR. LYMAN J. BRIGGS, of the Bureau of Standards, gave an illustrated lecture before the Franklin Institute in Philadelphia on February 15, on "The resistance of the air."

DR. HENRY S. WASHINGTON gave recently a series of four lectures to the students in the Geological Department of McGill University on the subjects of "The distribution of metals in the earth's crust," "Isostacy and rock deformation," "Petrographical classification," and "Co-magmatic regions."

PROFESSOR ROGER ADAMS, of the University of Illinois, lectured before the Columbus Section of the American Chemical Society on February 20 on "Synthetic drugs."

MR. B. G. LAMME, chief engineer of the Westinghouse Company, lectured at the Ohio State University on February 24, under the auspices of the University Branch of the American Institute of Electrical Engineers. Following the lecture, there was a smoker by the members of the Society for the Promotion of Engineering Education. Mr. Lamme, Mr. C. S. Coler, of the educational department of the Westinghouse Company, and Dr. W. H. Kennerson, of Brown University, addressed this meeting on various phases of engineering education.

ADDITIONAL lectures at the Brooklyn Botanic Garden this spring are as follows: On March 23 at 3:30 p.m., "The flora of Greenland: Its affinity to surrounding Arctic lands and probable history," Dr. Morton P. Porsild, director of the Danish Arctic Station, Disko, Greenland; and on April 16 at 4 p.m., "The virgin forest of Java," by Professor J. P. Lotsy, director of the Museum, Haarlem, Holland.

MAJ. JAMES E. MILLS, U. S. Army, delivered the following series of lectures at the University of North Carolina on February 24 and 25:

"Chemical warfare," to the student body; "The properties of a substance that determine its use in chemical warfare," to the students of chemistry; "Chemical warfare—methods of attack and defense," to the Elisha Mitchell Scientific Society.

DR. FRANK BOTTOMLEY died of pneumonia on January 16 at the age of 47. Dr. Bottomley had done valuable work in chemistry and physics. As *Nature* notes, heredity and environment conspired to make him a man of science. His great-grandfather was Dr. James Thomson, professor of mathematics in Glasgow University; his great-uncles were Lord Kelvin and James Thomson, F.R.S., professor of engineering in Queen's College, Belfast, and Glasgow University; while his father is the present Dr. James Thomson Bottomley, F.R.S., of Glasgow University.

THE President has approved a joint resolution accepting the invitation of Brazil to participate in an international exposition to be held in Rio de Janeiro, from September to November, 1922, in commemoration of the centenary of the independence of Brazil. A deficiency appropriation act approved December 15, 1921, carries an appropriation of $1,000,000 for this purpose. Under the terms of the joint resolution exhibits are provided of farming, cattle industry, mining, mechanics, transportation, communication, commerce, science, fine arts, forestry, fisheries, and manufacturing.

ACCORDING to the *Journal* of the American Medical Association, a society has been organized at Freiburg i. B., the headquarters in the publishing house of T. Fischer, which aims to publish the *Bildarchiv,* the purpose of which is to collect and make possible the rational utilization of scientific illustrations for teaching and other purposes. Besides a central headquarters for negatives and illustrations, it is proposed to make possible the publication of illustrations in a more perfect form than would be possible for private individuals.

THE topics appointed for discussion at the next international congress on the history of medicine are: (1) The principal foci of epidemic and endemic diseases of the middle ages in the Occident and the classic Orient, and (2) The history of anatomy. The congress is to be held at London on July 24-29, 1922, Professor Singer, of Oxford, to preside. The officers of the International Society for the History of Medicine are Giordano, of Venice; Singer, of Oxford; Jeanselme and Menetrier, of Paris, with Tricot-Royer, president. Laignel-Lavastine is the secretary. His address is rue de Rome, 45, Paris.

THE Tenth International Congress of Otology will be held in Paris from July 19 to July 22, 1922, under the patronage of M. Bernard, minister of education, and will be presided over by Professor Pierre Sebileau.

PUBLICATION of the *Geographic News Bulletins,* distributed weekly to schools for the past two years by the National Geographic Society through the Bureau of Education, but recently discontinued because of restriction of franking privilege by the Government, will be resumed. A charge will be made for postage.

THE trustees of the American Medical Association have made an appropriation of $1,500 to further meritorious research in subjects relating to scientific medicine and of practical interest to the medical profession, which otherwise could not be carried on to completion. Applications for small grants should be sent to the Committee on Scientific Research, American Medical Association, 535 North Dearborn Street, Chicago, before March 15, 1922, when action will be taken on the applications at hand.

THE *Journal* of the Washington Academy of Science reports that by a proclamation of President Harding, signed January 24, a 593-acre tract in the Nevada National Forest has been set aside as the Lehman Caves National Monument. The area remains a part of the National Forest, but can be used for no purpose which interferes with its preservation as a national monument. The caves are in a limestone formation at the base of Mt. Wheeler, at an altitude of 7,200 feet, and contain a remarkable series of stalactites and stalagmites.

FOR the purpose of encouraging research work on glass, the research committee of the

Glass Division of the American Ceramic Society has made arrangements for providing glass of desired composition and desired form for investigators in this field. The material will be supplied free of charge and no limitations as to the nature of the research will be imposed. The recipients of the material will be under no obligations except that of publication of the results of their investigations. The committee, however, requests that wherever possible the *Journal* of the American Ceramic Society be given preference in reporting the results. Persons who are interested are requested to address their inquiries to one of the following members of the committee on research: E. C. Sullivan, Corning Glass Works, Corning, New York; E. W. Washburn, University of Illinois, Urbana, Illinois; R. B. Sosman, Geophysical Laboratory, Washington, D. C.

UNIVERSITY AND EDUCATIONAL NOTES

WILLIAMS COLLEGE alumni are planning to raise $1,500,000 during the coming spring. One million of this sum, of which $200,000 has been pledged as a contingent gift by the General Education Board, is to provide adequate endowment for professors' salaries. The remaining $500,000 is to be used towards more complete facilities for physical education.

NORTHWESTERN UNIVERSITY has been notified that the General Education Board, of New York (the Rockefeller Foundation) has appropriated $600,000 for increase of faculty salaries, provided the university raises $1,400,000.

AT the Tulane University of Louisiana School of Medicine, New Orleans, it is planned to erect a new modern hospital on the university campus at a cost of between $1,000,000 and $2,000,000. The hospital will be in connection with the medical school of the university.

STATE appropriations of the New York legislature for the College of Agriculture at Ithaca include $83,000 for the construction of a new wing on the main building of the Veterinary Building, and $183,000 for equipment for the new Dairy Building. This budget is somewhat larger than usual and will permit more extension work by the college.

DR. MARION EDWARDS PARK, dean of Radcliffe College, has been elected president of Bryn Mawr College, to succeed M. Carey Thomas, who retires at the end of the present academic year.

PROFESSOR WILLIAM F. OSGOOD, of the mathematics department, has been appointed acting dean of the Graduate School of Arts and Science of Harvard University for the second half year. Dean Haskins is on leave of absence for that period so that he may recuperate after an attack of influenza.

PROFESSOR J. W. BARTON, associate professor of psychology in the School of Education of the University of Idaho, has been promoted to a full professorship of psychology. Mr. C. W. Chenoweth (M.A., Harvard) has been elected associate professor of philosophy.

DR. HENRI CLAUDE, associate professor and physician to the Saint-Antoine Hospital, has been appointed to the chair of clinical mental diseases and diseases of the brain in the Paris School of Medicine, to succeed the late Professor Dupré.

DR. GEORGE J. HEUER, associate professor of surgery at the Johns Hopkins Medical School, has accepted the professorship of surgery in the Medical College of the University of Cincinnati.

DISCUSSION AND CORRESPONDENCE

PRACTICABLE SUBSTITUTES FOR GRAIN ALCOHOL

USE of ethyl or grain alcohol for laboratory purposes has long involved certain difficulties connected with securing it tax-free and preserving it for its intended uses only. Since the passage of the various prohibition statutes the observance of the necessary regulations governing its use occasions far more trouble, while those who are interested in putting it to unscientific uses make the guardianship of the precious fluid a serious responsibility. Sub-

stitutes for grain alcohol, which would be unpotable and free from internal revenue taxation and prohibition regulations, are greatly desirable. Ordinary denatured alcohol, while useful for some laboratory purposes, is not satisfactory for most uses because of the character of the denaturants; and the use of a special denaturing formula is so involved in regulations as to be almost impossible.

A considerable series of experiments has shown that *isopropyl* and chemically pure *methyl* alcohols will fulfill practically any use for which alcohol is needed in biological work. It is indicated that inhalation of fumes of isopropyl alcohol does not have dangerous consequences; certainly, in any properly ventilated place the fumes would not be a danger. The experience of those who work in factories where methyl alcohol is produced, and who at times inhale the fumes in large quantity, shows that there is also little to be feared from its use in the laboratory. Experiments along this line are in progress. Probably most persons would prefer to use isopropyl alcohol for those purposes which might cause considerable quantities of the fumes to be inhaled. But both alcohols can be used with perfect safety for histological or other ordinary purposes. Out of consideration for those who consider alcohol a beverage all containers of both these alcohols should display warning labels.

The commercial grade of isopropyl alcohol contains 91 to 92 per cent. of the alcohol, while the similar grade of ethyl alcohol is 95 to 96 per cent. A purer grade of isopropyl alcohol, 98 to 99 per cent., can be supplied by the manufacturers, which can be made anhydrous by ordinary procedures.

"Chemically pure" methyl alcohol is practically anhydrous, and being less hygroscopic than ethyl alcohol is more useful and reliable for such purposes as dehydrating tissues than the anhydrous ("absolute") ethyl alcohol. As it contains only a trace of acetone it is entirely without the disagreeable odor of ordinary wood alcohol.

Both isopropyl and methyl alcohols have been tested against ethyl alcohol in the preparation of reagents, and in histological work done with such reagents and stains, as well as in the preservation of museum specimens. No differences could be detected in favor of either of them, except that the methyl alcohol proved much more satisfactory as a dehydrating agent.

In addition to the advantage that methyl and isopropyl alcohols have of being free from vexatious regulations and the danger of irregular use, they possess the additional merit of competing in price with the tax-free commercial ethyl alcohol.

LAWRENCE E. GRIFFIN
REED COLLEGE

IRIDESCENT CLOUDS

ON the afternoon of January 21, beginning before four and lasting perhaps an hour, an unusual set of iridescent cloud phenomena was seen in the southwest. Low in the sky, partly hiding the sun, were thick clouds edged with brilliant gold, which remained practically stationary. Higher up the sky was for the most part clear, with occasional cirro-cumulus clouds, many finger-shaped and pointing downward to a point north of the sun. The edges of these clouds were quite definite, and surrounding the tips and sides were two or three alternate narrow parallel bands of bright pink and green, the outer band in most cases being pink and the color extending at times 45° from the sun. Some of the clouds showed flocculent edges, giving an appearance of a colored fringe and one cloud broke up entirely into horizontal flecks and disappeared as it passed the zenith. Besides these were detached clouds which showed brilliant iridescent colors throughout the whole. One thin flocculent cloud showed small uniformly distributed flecks of pink and green, a larger one showed four irregular vertical bands of pink and green which covered the whole cloud, several glowed with lurid irregular patches of colors such as are seen in a thin film of oil on water. In one case a small spot of dark rose appeared against a misty blue background, rapidly grew into a pillar of vivid mottled colors, and then stretched out toward the northeast to form a white streamer all the way across the sky, its western portion being bordered with the characteristic pink and green bands.

These colors appear to be characteristic interference effects. Stoney[1] describes almost identical phenomena and states the conditions under which there would be formed crystals of such orientation and thickness that light reflected to the observer from the front and back surfaces of the crystal would produce interference. The explanation based on diffraction which McConnel[2] offers in criticism of Stoney's article does not seem to fit the phenomena observed here. His theory does satisfactorily explain the effects which he observed during a winter spent where similar phenomena were frequent, but there the brightest colors were within a range of from 3° to 7° from the sun and the farthest distance at which he could ever detect any color was 23°. He says that according to Stoney's theory the most brilliant effects might reasonably be expected somewhere about 20°-30° from the sun "for which we should look in vain." There were in this case few if any iridescent colors within the area where he found them most brilliant, and certainly beyond 23° they were very brilliant. It would therefore appear that there are these two different types of phenomenon.

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[1] *Phil. Mag.*, s. 5, Vol. 24, p. 87.

[2] *Phil. Mag.*, s. 5, Vol. 24, p. 423.

QUOTATIONS

THE PROPOSED SUPPRESSION OF THE TEACHING OF EVOLUTION[1]

THE mode of origin of species was practically discovered by a little-known German paleontologist by the name of Waagen in 1869, but, like the great discovery of Mendel in heredity, this truth has been long in making its way, even among biologists. Waagen's observations that species do not originate by chance or by accident, as Darwin at one time supposed, but through a continuous and well-ordered process, has since been confirmed by an overwhelming volume of testimony, so that we are now able to asemble and place in order line after line of animals in their true evolutionary succession, extending, in the case of what I have called the édition de luxe of the horses, over millions of years. We speak to the earth from Eocene times onward to the closing age of man, and it always teaches us exactly the same story. These facts are so well known and make up such an army of evidence, that they form the chief foundation of the statement that evolution has long since passed out of the domain of hypothesis and theory, to which Mr. Bryan refers, into the domain of natural law.

Evolution takes its place with the gravitation law of Newton. It should be taught in our schools simply as Nature speaks to us about it, and entirely separated from the opinions, materialistic or theistic, which have clustered about it. This simple, direct teaching of Nature is full of moral and spiritual force, if we keep the element of human opinion out of it. The moral principle inherent in evolution is that nothing can be gained in this world without an effort; the ethical principle inherent in evolution is that the best only has the right to survive; the spiritual principle in evolution is the evidence of beauty, of order, and of design in the daily myriad of miracles to which we owe our existence. This is my answer to Mr. Bryan's very natural solicitude about the influence of evolution in our schools and colleges—a solicitude not inherent in the subject itself, but in the foolishness and conceit of certain of the teachers who are privileged to teach of the processes of life.

It would not be true to say that the evolution of man rests upon evidence as complete as that of the horse, for example, because we have only traced man's ancestors back for a period of 400,000 years, as geologic time was conservatively estimated in 1893 by Secretary Walcott of the Smithsonian Institution, Washington; whereas, we have traced the horse back for a period of 3,000,000 years, according to similar estimates of geologic time.

The very recent discovery of Tertiary man, which I have just described in *Natural History* (November-December, 1921), living long before the Ice Age, certainly capable of walking in an erect position, having a hand and a foot fashioned like our own, also a brain of suffi-

[1] Extracts from articles in the New York *Times* for March 5, in answer to the article by Mr. Bryan from which extracts were printed in the last issue of SCIENCE.

cient intelligence to fashion many different kinds of implements, to make a fire, to make flint tools which may have been used for the dressing of hides as clothing, constitutes the most convincing answer to Mr. Bryan's call for more evidence. It once more reminds us of the ignorance of man of the processes of Nature, and sets a new boundary beyond which digging in the earth for more of truth must be directed. This Foxhall man, found near Ipswich, England, thus far known only by the flint implements he made and his fire, is the last bit of evidence in the direction of giving man a descent line of his own far back in geologic time. It tends to remove man still further from the great lines which led to the man apes, the chimpanzee, the orang, the gorilla and the gibbon. This is not guess work, this is a fact. It is another truth which we shall have to accept regardless of its effect. No naturalist has ever ventured to place man so far back in geologic time as this actual discovery of the Foxhall man places him. In this instance again truth is stranger than hypothesis or speculation.

Nearer to us is the Piltdown man, found not far from 75 miles to the southwest of Ipswich, England; still nearer in geologic time is the Heidelberg man, found on the Neckar River: still nearer is the Neanderthal man, whom we now know all about—his frame, his head form, his industries, his ceremonial burial of the dead, also evidence of his belief in a future existence; nearer still is the Cro-Magnon man, who lived about 30,000 years ago, our equal if not our superior in intelligence. This chain of human ancestors was totally unknown to Darwin. He could not have even dreamed of such a flood of proof and truth. It is a dramatic circumstance that Darwin had within his reach the head of the Neanderthal man without realizing that it constituted the "missing link" between man and the lower order of creation. All this evidence is to-day within reach of every schoolboy. It is at the service of Mr. Bryan. It will, we are convinced, satisfactorily answer in the negative his question: "Is it not more rational to believe in the creation of man by separate act of God than to believe in evolution without a particle of evidence?"

HENRY FAIRFIELD OSBORN

Is it any more degrading to hold that man was made through a long line of animal ancestry than to believe that he was made directly from the dust? Surely the horse and the dog and the monkey belong to higher orders of existence than do the clod and the stone. Whether we accept the teachings of evolution or the most literal interpretation of the Biblical account we are compelled to recognize the fact that our bodily origin has been a humble one; as Sir Charles Lyell once said, "It is mud or monkey." But this lowly origin does not destroy the dignity of man; his real dignity consists not in his origin but in what he is and in what he may become.

If only the theological opponents of evolution could learn anything from past attempts to confute science by the Bible they would be more cautious. It was once believed universally that the earth was flat and that it was roofed over by a solid "firmament," and when scientific evidence was adduced to show that the earth was a sphere and that the "firmament" was not a solid roof, it was denounced as opposed to the Scriptures. Those who have visited the Columbian Library in the Cathedral of Seville will recall the Bible of Columbus with marginal notes in his own handwriting to prove that the sphericity of the earth was not opposed to the Scriptures, and a treatise written by him while in prison to pacify the Inquisition. To-day only Voliva and his followers at Zion City maintain that the earth is flat, and the heavens a solid dome, because this is apparently taught by the Scriptures.

The central position of the earth in the universe with all heavenly bodies revolving around it was held to be as certain as holy writ. All the world knows the story of "Starry Galileo and His Woes" at the hands of the Inquisition, but the Copernican theory was opposed not only by the Roman Catholic Church, but also by the leaders of the Reformation. Martin Luther denounced it as "the work of a fool"; Melanchthon declared that it was neither honest nor decent to teach this pernicious doctrine, and that it should be repressed by severe measures, and John Wesley declared that it "tended toward infidelity." Even as late as 1724 the Newtonian theory of gravity was

assailed by eminent authorities as "atheistic," since "it drove God out of His universe and put a law in His place."

The conflict between geology and Genesis as to the days of creation and the age of the earth lasted until the middle of the last century, and students of Dana's geology will recall the reconciliation between the two which that great man devoutly undertook. But, by the ultra-orthodox, he and other Christian geologists were denounced as infidels and as impugners of the sacred record. It took three hundred years to end this conflict, if it may be said to be wholly ended now, but certainly no intelligent person now believes that the earth was made just 5,926 years ago and in six literal days.

And now comes Mr. Bryan in this twentieth century of enlightenment preaching a new *auto de fe,* attempting to establish an inquisition for the trial of science at the bar of theology! He proposes to prohibit the teaching of evolution by fine and imprisonment, to repeal a law of nature by a law of Kentucky. He proposes to gather into the fold of his narrow theology all existing public and private schools, colleges and universities and to allow evolutionists and agnostics to found their own schools. In view of the fact that, with the exception of a few sectarian institutions, all our colleges and universities are dedicated to "the increase and diffusion of knowledge among men," that for a generation at least they have turned away from the teaching of dogmatic theology to the cultivation of science, literature and art, that they have during this period received great benefactions for the expressed or implied purpose of carrying on this work in the spirit of freedom to seek, to find and to teach the truth as God gives men to see the truth—in view of these considerations it may well be asked whether it would not be more fitting for Mr. Bryan to establish his own institution for teaching his own views of science and theology, as Dowie, for example, did at Zion City, rather than to attempt to convert existing institutions to that purpose.

Scientific investigators and productive scholars in almost every field have long since accepted evolution in the broadest sense as an established fact. Science now deals with the evolution of the elements, of the stars and solar system, of the earth, of life upon the earth, of various types and species of plants and animals, of the body, mind and society of man, of science, art, government, education and religion. In the light of this great generalization all sciences, and especially those which have to do with living things, have made more progress in the last half century than in all the previous centuries of human history. Even progressive theology has come to regard evolution as an ally rather than as an enemy.

In the face of all these facts, Mr. Bryan and his kind hurl their medieval theology. It would be amusing if it were not so pathetic and disheartening to see these modern defenders of the faith beating their gongs and firing their giant crackers against the ramparts of science.

Edwin Grant Conklin

NOTES ON WOODS

West Indian Boxwood

There has been much confusion regarding the identity of the so-called West Indian boxwoods. One of the first on the market was the "amarillo" of Venezuela, *Aspidosperma Vargasii* DC. (Apocynaceæ), but this has been very largely superseded by the "zapatero," *Casearia præcox* Griseb. (Samydaceæ or Flacourtiaceæ). A third, the "baitoa" of San Domingo, appears on the market in considerable quantity, though it is inferior in quality to the other two. It has just been determined that this wood is produced by *Phyllostylon brasiliensis* Capanema (= *P. rhamnoides* Taubert = *Samaroceltis rhamnoides* Poisson) of the family Ulmaceæ. It occurs not only in Hispaniola and eastern Cuba but also in Brazil and Argentina. The important distinguishing features of this wood are as follows: (1) About half of the vessels are filled with calcium carbonate. (2) The wood fibers are supplied with a thick gelatinous layer. (3) The vessel segments, wood parenchyma strands and some of the rays are in horizontal seriation. The "ripple marks" are not always distinct in the wood but are readily visible on the surface of

the inner bark. (See Bul. Tor. Bot. Club, 48: 297-306).

The statement, which appears so persistently in books, that West Indian boxwood is supplied by *Tabebuia* (*Tecoma*) *pentaphylla* B. & H. f. (Bignoniaceæ), is incorrect. Authentic specimens of the wood of this species have been examined by the writer and they have none of the characters of a boxwood. This error arose in 1884 and was due to an improper identification of a specimen of "zapatero" in the Royal Botanic Gardens, Kew. The correct identity of this wood was established twenty years later but the error persists. (See Kew Bul. Misc. Inf., 1904, pp. 11-12, and 1914, pp. 214-219).

BRAZILIAN TULIP-WOOD

THIS beautiful wood has been used for a great many years for inlay and cabinet work. In typical specimens the background of yellow is striped with rose-red; in others the red predominates. In a paper on "Storied or tier-like structure of certain dicotyledonous woods" (Bull. Tor. Bot. Club, 46:260) the writer made this statement:

"The only representative of the Lythraceæ included in the list is *Physocalymma scaberrimum* Pohl, variously known as Brazilian tulip-wood, rose wood, 'páo de rosa,' 'cego machada,' 'grão de porco' and 'sebastião de arruda.' Writers all seem to be in agreement in referring this wood to the species mentioned, but the specimens examined by the writer, which are evidently the same as those described by Wiesner (Rohstoffe d. Pflanzenreiches, 2:975), appear to belong to the Leguminosæ. They certainly do not resemble other available material of the Lythraceæ."

Very recently, through the courtesy of the New York Botanical Garden, the writer had opportunity to study the wood of *Physocalymma* and was enabled to determine positively that the Brazilian tulip-wood of commerce is not of that genus. Unquestionably it is a legume but exact identification is not at the moment possible.

COFFEE-WOOD

THE wood principally used in the manufacture of umbrella handles comes mostly from Venezuela where the name "granadillo" seems to be applied to it. In the New York trade it is known as "coffee-wood" or "brown ebony"; also as "mesquite." In European markets it is called "partridge-wood." All of these names, with the exception perhaps of "coffee-wood," are also applied to entirely different woods.

The identity of this wood has not been positively determined, but from the evidence at hand it appears to be *Cæsalpinia Ebano* Karst. This wood is known as "ebano" in Venezuela as is also that of *C. punctata* Willd. The writer has not had opportunity to examine the latter but the structure and properties of *C. Ebano* agree very closely with that of the wood on the market.

It is said that part of the trade is supplied by a wood from Mexico but no samples known to be of this source are available for comparison.

ROSEWOOD

THERE are many woods on the market under the name of "rosewood." Some derive the name from the scent of the wood, others from the color, and still others for no apparent reason at all.

The Surinam rosewood or "rozenhout" owes its name to its fragrance and is the source of an essential oil of commerce. The identity of this wood has only recently been established by Gonggrijp (De Indische Mercuur, Apr. 23 and 20, 1920) as *Aniba* sp. (near *panurensis* Mez.).

The true Brazilian rosewood has been variously ascribed to the genera *Jacaranda, Dalbergia,* and *Machærium.* The first is an error arising from a confusion of the local name, "jacarandá," with the generic. A specimen of the true rosewood collected by Mr. H. M. Curran with botanical specimens has been identified as *Dalbergia nigra* Fr. All. Certain varieties are recognized in the trade, based largely on variations in color, but the structure indicates a single species. There are other woods called "jacarandá" in Brazil which are likely species of *Machærium* but they lack the scent of the true rosewood and are distinct in structure from it.

The botanical status of the Honduras "rosewood," which is considered the best wood in the world for xylophone bars, has not been determined. It is unquestionably one of the Leguminosæ and may prove to be a species of *Dalbergia*.

COCOBOLO

This wood, which is used so extensively in the manufacture of knife handles, comes from Panama, Costa Rica, Nicaragua and Mexico. The tree in Panama has been positively determined as *Dalbergia retusa* Hemsley, and the wood is exported as "rosewood"; the Nicaraguan species is *Dalbergia hypoleuca* Pittier in ed. and is locally known as "nnambar"; that of Mexico, called "granadillo," is very likely a new species.

Workmen in factories where cocobolo is used are likely to suffer from an acute dermatitis resembling ivy-poisoning. Many are apparently immune while others are highly susceptible. A person once infected becomes more rather than less susceptible to the poison. The only known means of infection is through the fine dust arising in working the wood. Some investigators believe the irritation is due to an oil, others to an alkaloid. (See Raw Material, 4: 11: 402-406, November, 1921, for fuller account). According to Boorsma (L'Institut Botanique de Buitenzorg, 14: 19, 1902) small amounts of alkaloid occur in the following species: *Dalbergia litoralis* Hassk, *D. Junghuhnii* Benth., and *D. Championii*.

The East Indian satinwood, *Chloroxylon Swietenia* DC., causes a dermatitis very similar to that from cocobolo. (See Cash, Brit. Med. Jour., Oct. 7, 1911). An alkaloid, chloroxylin, has been found which is considered to be the source of the infection. (Manson Ault, J. Chem. Soc. 1909, 95:964).

"REDWOOD" AND SATINÉ

The "redwood" or "quira" of Panama has been determined to be *Platymiscium dubium* Pittier. A wood of similar structure from Nicaragua is on the New York market under the name of "Yama cocobolo" or "Yama rosewood." It is also called "leather-wood."

The "redwood" of Brazil is from the tree named *Brosimum parænse* by Huber. It is known locally as "muirapiranga" and "conduru de sangue" and is similar to the Peruvian "palo de sangre." It is not now on our market but dealers are in receipt of samples which indicate that it may be expected. The name of "Brazilian cardinal wood" has been suggested for it. It has good cabinet qualities and retains its bright red or cardinal color. It is much like, and may prove to be identical with, the "satiné" or "bois de féroles" of French Guiana. Owing to the confusion of the names "bois de féroles" with the generic name *Ferolia*, the satiné has been incorrectly ascribed to *Ferolia* (*Parinarium guaianensis* Aubl. (Rosaceæ). (See Stone's "Les bois utilés de la Guyane Francaise." Ann. d. Musee Col. de Marseille, 1917).

Wood specimens of satiné rulianné have been received from the Forest Service of Surinam and agree perfectly with the material described by Stone (*loc. cit.*) under that name. Leaves and twigs from the same tree as the wood specimens have been examined by Dr. Standley of the Smithsonian Institution and he says that the material agrees best with *Brosimum paraense* Huber, though in the absence of fruit (which the Conservator of Forests has undertaken to procure) such identification is only provisional. If this identification proves to be correct it will likely follow that Aublett's *Ferolia guianensis* is a synonym, since his description seems to fit this tree.

The satiné rubanné growing in the tropical rain forest of Surinam attains a diameter of two feet and has a white latex in the bark. The Arowak Indians call it "oolemeriballi," "warimiaballi," and "sokonéballi," while the negro letterwood-hunters have named it "ajeersi," meaning "it looks like it," that is, it looks like the letterwood or snakewood (*Piratinera guianensis* Aubl.).

KAKATARA-BALLI

This is a dull-white wood of British Guiana described by Stone and Freeman as No. 46 in their list of Timbers of British Guiana. A microscopic examination reveals that the ground mass is composed of spiral fiber-tracheids, the vessels have scalariform perfora-

tions with many bars, and the rays are large and composite or heterogeneous. The natural conclusion is that this wood must be from some species of *Ilex*.

This finding has since been confirmed by the Forestry Officer of British Guiana.

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SPECIAL ARTICLES

GENETICS OF THE VIENNA WHITE RABBIT

IN the second edition of his text-book[1], Dr. Erwin Baur described a cross between two white varieties of rabbit which produced colored young. One of the white varieties is the familiar pink-eyed albino, the other is called Vienna White and is described by Baur as differing from the albino variety only in the color of the eyes, which are blue. He explains the production of colored young in this cross as due to the complementary action of two independent color factors, like the well known cases among plants in which a cross between two white-flowered varieties produces progeny bearing colored flowers.

It happens that the colored young rabbit figured by Baur as resulting from the cross was Dutch marked, and this led Punnett to suppose that the blue-eyed white parent was really a Dutch rabbit in which the white areas had attained a maximum extension so as to cover the entire coat. This interpretation seemed reasonable to me until I recently obtained in some breeding experiments animals similar to Baur's Vienna Whites, when it became clear that they have no relation to Dutch marking, and also that the relation of Vienna White to albinism is much closer than Baur had supposed.

The color factor of Vienna White is in fact an allelomorph of albinism. If Baur had used in the cross with Vienna White an albino whose parents were *yellow*, he would not have obtained colored young but only blue-eyed whites or albinos, which result would have shown that the two white varieties are not due to complementary factors but to allelomorphic conditions of one and the same factor.

The case is strictly analogous with that of the silver agouti guinea-pig as worked out by Castle and Wright[2] several years ago. The so-called color factor has in guinea-pigs several allelomorphic states, as shown by Wright. The two with which we were then concerned produce respectively (1) the ordinary albino or all-white coat associated with pink-eyes and (2) a condition in which the coat develops black pigment but no yellow pigment, and the eyes are red, not pink. By suitable crosses the gene for yellow coat can be introduced into the red-eyed variety. But since (1) the gene for yellow inhibits the development of *black* pigment in the coat and (2) the gene for red-eye (the color allelomorph) inhibits the development of *yellow* in the coat, it follows that the coat, in what is genetically a red-eyed yellow animal, contains *neither* black nor yellow pigment and so is white. Only the red eye-color then serves to distinguish the animal from an albino. It is in fact a red-eyed white in appearance, but genetically is a red-eyed yellow and if crossed with yellow animals will produce yellow young.

Now in rabbits we have a strictly parallel situation. The chinchilla[3] rabbit corresponds with the red-eyed silver agouti guinea-pig. Its coat contains black pigment but not yellow. If we cross chinchilla with albino, we obtain chinchilla young, not gray, indicating that chinchilla and albinism are allelomorphs, not complementary factors. If the albino parent carries the gene for yellow coat, then in F_2 we obtain chinchillas, albinos, and "blue-eyed whites." The last are obviously yellow chinchillas. I have not been able to obtain as yet the Vienna White variety from Europe, but those who have them can easily put this interpretation to the test by crossing Vienna White with a yellow coated variety. If my interpretation is correct, they will obtain yellow young from the cross.

[1] Einführung in die experimentelle Vererbungslehre, Berlin, 1914.

[2] Carnegie Institution of Wash., Publ. No. 241, 1916.

[3] Castle, W. E., Genetics of the chinchilla rabbit, SCIENCE, April 22, 1921.

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